BACKWASH METHOD

FIELD OF THE INVENTION

The present invention relates to membrane filtration systems, and more particularly to those systems employing porous or permeable membranes located in a tank or cell open to atmosphere and a backwash method and arrangement therefor.

BACKGROUND ART

Any discussion of the prior art throughout the specification should in no way be considered as an admission that such prior art is widely known or forms part of common general knowledge in the field.

Porous membrane filtration systems require regular backwashing of the membranes to maintain filtration efficiency and flux while reducing transmembrane pressure (TMP) which rises as the membrane pores become clogged with impurities. Typically, during the backwash cycle the impurities are forced out of the membrane pores by pressurised gas, liquid or both into the feed tank or cell. Impurities may also be removed from the membrane surfaces by scouring with gas bubbles. The liquid containing impurities and deposits from the membranes is then drained or flushed from the tank.

The waste liquid displaced from the tank needs to be disposed of or reprocessed, usually in an environmentally safe manner, so any reduction in the volume of such waste liquid is seen as advantageous in terms of environmental impact and cost.

The draining or flushing of the tank, particularly when large arrays of membranes are used also requires time which results in down time of the filtration cycle. In order to reduce this down time large pumping systems are required to quickly drain and refill the tank. Where tanks or cells are arranged in banks and feed is used to refill the tank, a lowering in levels in other cells may be produced during the refill process. This again impinges on operating efficiency of the filtration system.

Further, in filtration systems employing gas bubble scouring of the membranes it has been found advantageous to confine the bubbles as much as possible in the region of the membranes to assist with the scouring process.

Reduction in backwash volume also reduces the volume of chemical cleaning agents required in some systems. This has the two-fold advantage of reducing cost in terms of chemical requirements while also reducing waste disposal problems.

Minimising the footprint of filtration systems is also desirable in terms of space eventually occupied by the filtration plant. Compact systems have lesser impact on the environment and are more acceptable to the market.

The distribution of gas across large membrane module arrays often leads to complex distribution systems and thus it is desirable to reduce the complexity of such systems where possible.

It has been found advantageous to reduce the volume of feed liquid in the filtration cell as well as confine scouring bubbles as much as possible in order to

ameliorate the above problems and provide at least some of the advantages outlined above.

DISCLOSURE OF THE INVENTION

The present invention seeks to overcome one or more of the abovementioned problems of the prior art, provide one or more of the advantages outlined above or at least provide a useful alternative.

According to one aspect, the present invention provides a filtration arrangement including one or more membrane modules positioned vertically within a feed tank, each membrane module having one or more membranes positioned therein, an aeration hood having an upper wall and one or more downwardly extending side walls configured to at least partially shroud said membrane modules within said tank, said aeration hood including a number of open-ended tubes, each extending downwardly from said upper wall and forming a respective opening therein, each tube adapted to have at least one of said modules mounted therein and extending through said respective openings in the upper wall so as to at least partially surround an outer periphery of an associated module or modules, one or more aeration openings being provided in each tube at a location spaced from a proximal end of said tube, said aeration hood side wall or walls extending to below the location of said aeration openings in said tubes, and gas providing means for feeding gas into said hood.

In one preferred form, one or more of said aeration hood side walls are formed by side walls of the feed tank with the upper wall being sealingly attached to the side wall so formed.

For preference, the aeration openings are provided at or adjacent the distal end of each tube and the aeration hood side wall or walls extend to or below the downward extent of a distal end of said tubes.

Preferably, each membrane module has an associated tube surrounding an outer periphery thereof. For preference, the openings comprise a number of through holes located around the periphery of each tube and spaced from the distal end of said tube. In one form, the gas providing means may comprise an aeration header located below the aeration hood.

In one preferred form, the at least one module includes a sleeve surrounding the outer periphery to prevent flow of gas therethrough. The sleeve extends part way along the length of the module to define an open region at or adjacent the lower end of the module to allow flow of gas into the module through said open region, and the hood is positioned to shroud the module at the location of the open region such that gas passing through the aeration openings may pass through the open region into the module membranes.

Desirably openings or an open region are also provided at the top of the module to allow escape of the gas from the module and entry of liquid into the module.

According to another aspect, the present invention provides a method of cleaning membrane modules in arrangement according to the above aspect including the steps of:

i) suspending the filtration operation;

ii) displacing feed liquid within the aeration hood to a level below the location of said aeration openings in each tube by feeding gas into

said aeration hood while maintaining a liquid seal with the distal end of each tube;

iii) passing said gas through said aeration openings into said tubes and along surfaces of membranes within each membrane module to dislodge accumulated fouling materials therefrom;

iv) recommencing the filtration operation.

BRIEF DESCRIPTION OF THE DRAWING

A preferred embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 shows a pictorial perspective view of one preferred embodiment of the invention; and

Figure 2 shows a simplified schematic side elevation view of one module of a further embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the Figure 1 of the drawings, the arrangement consists of a rack of membrane modules 5 suspended in an open feed tank 6 having a feed inlet 7. The modules 5 are suspended from a group manifold 8 which in turn is connected to main filtrate conduit 9 which extends across the top of the tank 6 and connects to each of the manifolds 8. Located and supported within the tank 6 is a hollow structure forming an aeration hood 10 consisting of an upper wall 11 and side walls 12 and 13. The aeration hood 10 has four side walls (two of which have been cutaway to show the internal configuration of the filter arrangement) and is open at its base. It will be appreciated that the walls of the

hood can be formed by the sides or walls of the feed tank 6 with the upper wall extending between the tank walls and being sealingly attached thereto (not shown). The aeration hood 10 further includes a number of open-ended tubes 14 corresponding to the number of membrane modules 5 which extend downwardly from the upper wall 11 and form openings 15 therein. Each module 5 is accommodated within a corresponding tube 14 which at least partially surrounds the outer periphery of each module 5. Adjacent the distal end 16 of each tube 14 and spaced around the circumference of the tube 14 is a row of aeration holes 17. The size and number of aeration holes will vary with type and size of module and requirements in terms of maintaining a desired pressure drop to ensure a liquid seal with the distal end 16 of the tube 14. Several rows of holes may be provided along the length of the tube 14 at spaced locations, each row having varying sized holes to control the flow of gas. While holes are shown, a variety of openings may be used including slots extending upwardly from the end of the tube 14. The use of slots may provide self-regulation of the desired pressure drop. A series of aeration lines 18 are provided along the bottom 18 of the feed tank 6.

The aeration and cleaning process according to this embodiment may be described as follows. The filtration process is suspended and backwash commenced with backwash gas, typically air, being supplied from aeration lines 18 under the aeration hood 10 so as to bubble up into the void space between the tubes 14. It will be appreciated that gas could also be fed directly into the aeration hood 10 through a pipe or the like. The gas that bubbles up from the aeration lines 18 displaces feed liquid from within the aeration hood 10. The liquid level in the aeration hood 10 drops until it is below the row of aeration

holes 17 near the distal end 16 of the tubes 14. The gas then flows through the holes 17 and into the sides of the module 5 suspended inside the tubes 14. This gas then provides a scrubbing action to scour the membranes within the module 5, whilst the tubes 14 serve to contain the gas within the module 5 thus promoting more effective cleaning.

The distal end 16 of the tube typically extends about 50 to 100mm below the aeration holes 17 in the tube 14, though it will be appreciated that the aeration holes may be located at any desired location along the length of the tube 14 and several rows of holes may be provided. The pressure drop across the aeration holes 17 is selected to ensure that a liquid seal is maintained between the holes 17 and the end 16 of the tubes 14. A gap 19 may also be provided between the end 16 of the tube 14 and the bottom 20 of the module 5 to allow solids to exit from the bottom 20 of the modules.

A further embodiment of hood arrangement is shown in Figure 2. In this embodiment, the membrane module 5 is provided with a sleeve or wrapping 21 along part of its length which assist with retention of aeration gas within the module 5. The sleeve 21 only extends along a part of the module length leaving an open region 22 adjacent the lower end 23 of the module 5. This open region 22 allows flow of feed, backwash and gas to and from the module 5. In this embodiment, the hood 10 is abbreviated in form and shrouds the module 5 at the location of the open region 22 so that the aeration openings 17 are positioned adjacent the open region 22 to allow free movement of aeration gas into the membranes of the module 5. A further open region or aperture (not

shown) is provided at the top of the module 5 to allow the escape of gas and flow of liquid to and from the module.

While the invention has been described in relation in relation to a feed tank open to atmosphere, it will be appreciated that the invention is equally applicable to a closed, pressurized filtration system.

It will be appreciated that further embodiments and exemplifications of the invention are possible without departing from the spirit or scope of the invention described.